UNITED STATES DISTRICT COURT
FOR THE DISTRICT OF MASSACHUSETTS

| | |
|---|---|
| DANA-FARBER CANCER INSTITUTE, INC. a/k/a THE JIMMY FUND<br><br>Plaintiff,<br><br>v.<br><br>BOC GROUP, INC. d/b/a BOC GASES<br>Defendant/Third-Party Plaintiff,<br><br>v.<br><br>TAYLOR-WHARTON, HARSCO CORPORATION, GAS & FLUID CONTROL GROUP and PACER DIGITAL SYSTEMS INC.<br><br>Third-Party Defendants. | Case No.: 04-CV-12612-RWZ |

**DANA-FARBER CANCER INSTITUTE'S RESPONSE IN OPPOSITION TO THIRD-PARTY DEFENDANTS' MOTION TO COMPEL DISCOVERY AND TO AMEND EXPERT DISCLOSURE DATE**

Third-Party Defendants Taylor Wharton (TW) and Pacer Digital Systems, Inc. (Pacer) request leave to re-inspect and destructively re-test critical evidence that they have jointly inspected and tested on two previous occasions. The previous inspection and testing was conducted pursuant to a protocol that was agreed to by all parties. TW and Pacer have already delayed this matter and this request for destruction testing and will cause further complication, delay and expense and will give TW and Pacer an unintended tactical advantage and should not be allowed.

On August 15, 2002 a Taylor Wharton (TW) liquid nitrogen freezer located at the Dana-Farber Cancer Institute (DFCI) catastrophically failed causing valuable biological research samples to thaw rendering them useless. The freezer and its digital control panel were manufactured and sold to defendant BOC by Third-Party Defendants Taylor Wharton and Pacer Digital (Pacer). BOC sold the freezer to DFCI and maintained it.

Just days before the failure, BOC was notified of problems with the freezer and was

asked to repair it. Because BOC's trained repairman was on vacation BOC sent salesman Bill Emmett according to DFCI's employees. Emmett inspected the freezer, decided that it was fully operational and that DFCI was worrying too much. He told DFCI to leave the freezer alone and not open it. The freezer failed shortly thereafter. Plaintiff's experts have determined that the freezer's Pacer digital control panel malfunctioned and should have been replaced when Emmett visited. Ironically the same freezer exhibited similar symptoms a few months ago and BOC properly changed the Pacer digital control panel avoiding another disaster. BOC repair staff carry spare control panels with them for just this sort of situation. BOC was negligent in failing to diagnose and repair properly the freezer.

As a result of the failure, DFCI made claim against its Chubb Insurance Company policy. Chubb paid DFCI in excess of $600,000.00. Chubb sued BOC alleging negligence, breach of contract and products liability to recover the money paid to DFCI. BOC in turn sued Taylor Wharton and Pacer Digital. Pacer responded with a counterclaim against BOC claiming that BOC's negligence caused the loss and demanding indemnification from BOC.

TW and Pacer now seek leave of court to circumvent the agreed-upon discovery schedule and conduct destructive testing of critical evidence which has already been tested and which they have inspected on two previous occasions pursuant to a mutually agreed upon test protocol. They also seek a unilateral extension of time to produce their expert reports, a deadline that they selected and then disregarded.

On June 14, 2005 the parties submitted a Proposed Joint Pre Trial Schedule (See Exhibit 1) with separate dates for the conclusion of fact discovery, expert disclosures and expert depositions. On January 25, 2006 the same parties submitted an Proposed Amended Joint Pre-Trial Schedule again listing separate dates for the conclusion of fact discovery, expert disclosures and the conclusion of expert depositions (See Exhibit 2). In the Proposed Amended Schedule Plaintiff was to provide expert disclosure by April 3, 2006.

In an effort to comply with the Amended Schedule Plaintiff scheduled the first evidence exam for March 16, 2006 ( See Exhibit 3: E-mail from Plaintiff's Counsel to Defense counsel). Counsel for TW and Pacer was not available for the inspection and suggested that Plaintiff's Expert Disclosure date be extended (See Exhibit 4: E-Mail from Mr. Wineholz to Counsel re: extension) and the planned inspection adjourned. At the behest of TW and Pacer's counsel, on March 17, 2006 the parties field a Stipulation amending the discovery schedule indicating that

fact discovery end on April 21, 2006, plaintiff to produce expert reports on May 3, 2006, defendant's expert disclosures on June 5, 2006 and Third-Party expert disclosures on July 5, 2006. (See Exhibit 5). The original time for the completion of expert depositions of September 29, 2006 was maintained in an effort to keep the case on track for trial. Mr. Weinholz modified the date for fact discovery in the Stipulation to facilitate the completion of depositions and the inspection of evidence prior to the time for expert disclosures (See Exhibit 6: E-mail from Mr. Weinholz to counsel regarding Stipulation to Extend). On March 22, 2006 counsel for Plaintiff forwarded a comprehensive test protocol for the inspection, testing and evaluation of the evidence. (See Exhibit 7: E-mail from Plaintiff's counsel enclosing test protocol). There were no objections, exceptions, additions or deletions to the protocol. The protocol specifies the equipment that will be used and the areas of the panel to be inspected.

Plaintiff re-scheduled the inspection of the evidence until March 29, 2006 and again TW/Pacer requested that the inspection be delayed indicating that their experts from Indiana were unavailable. (See Exhibit 8: E-mail from Plaintiff's counsel to Defense Counsel). The testing and inspection was again re-scheduled to accommodate TW and Pacer to April 5, 2006. (See Exhibit 9). Because the testing was not completed on April 5 another inspection/testing was scheduled for April 20, 2006 (See Exhibit 10). This date was selected so that all fact discovery including testing and inspection of the evidence would be completed before the expiration of the fact discovery deadline of April 21, 2006. All parties understood and agreed that the testing and inspection was to be completed as part of fact discovery. TW and Pacer were given a full and fair opportunity to attend and participate in the preparation of the test protocol and the inspection and testing of the evidence. Pacer sent experts from their Indiana corporate headquarters to both inspections and participated fully.

Plaintiff and defendant each identified their experts as required. The parties agreed to extend the time for Third-Party Expert Disclosures as indicated in Mr. Weinholz's June 19, 2006 letter (Exhibit 11). At no time did Plaintiff agree to extend the time for fact discovery or agree to allow further additional testing or inspections or the destructive testing now proposed by the Third-Party. (See Exhibit 12: Destructive Test Protocol attached to Mr. Weinholz's June 30, 2006 letter). TW and Pacer now propose to have Mr. Donald Geller disassemble , unsolder, cut and remove potions of the Pacer digital panel which is critical evidence and to produce its expert reports late.

The basis for this untimely proposal is that the Third Parties decided it would be "worthwhile to conduct a microscopic examination of the one area on the circuit board...". (See Affidavit of John Weinholz paragraph 9). The Third-Party does not claim that this further investigation is critical to its defense or even important but merely "worthwhile." There is no explanation why this testing is needed or what the defense hopes to accomplish with it. Mr. Weinholz's suggestion that plaintiff's experts not attend this destructive testing is unrealistic and untenable. This is critical evidence that is central to plaintiff's case. It involves the equipment that caused the failure and to suggest that the testing proceed without plaintiff's input is unacceptable. The defense must demonstrate that the exception to the agreed upon scheduling order is at least for good cause. At best the defense seeks to satisfy the curiosity of a recently retained expert at plaintiff's expense.

Mr. Weinholz's Affidavit creatively refers to this testing as a "microscopic examination" but the Geller protocol unquestionably calls for extensive destructive testing of critical evidence. The panel's oscillator is critical evidence that must be evaluated by the jury in order to evaluate the credibility of the expert witnesses. The proposed destructive testing will impair the jury's ability in this regard. [1]

The defense offers two excuses for the late testing and not even an explanation for the delay in production of expert reports. First they contend that the testing can be completed prior to the expiration of the agreed upon time for the completion of expert depositions so it should be allowed and next they claim that the defense did not realize that the crystal oscillator was significant. Neither are compelling reasons for extending the time for fact discovery or for allowing destructive testing or the late production of expert reports. All parties understood the spirit and letter of the discovery schedule. The defense misconstrues the deadlines and suggests, without explanation or analysis, that because the time for the completion of expert depositions to is September 29, 2006 that the time to conduct destructive testing and produce expert reports can

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[1] The significance of Plaintiff's experts' finding that the oscillator was the most likely cause of the failure seems to be lost on the Third-Party (See Exhibit 13: Plaintiff's expert report). Plaintiff's expert never definitively concludes that an oscillator failure was the cause of the loss but rather points to the potential oscillator failure, along with other evidence of the panel's failure, to support his central opinion that the Pacer panel was the one and only source of the failure. Even if Mr. Geller were able to testify that an oscillator failure did not occur plaintiff's experts' opinion that the panel was the source of the failure would still be admissible and compelling.

be extended.

While few Massachusetts courts have discussed destructive evidence testing other courts have. The New York Supreme Court Appellate Division, Second, in Castro v. Leeds 116 A.D.2d 549(1986) discussed the parameters of destructive testing and required the party seeking the testing to provide a reasonably specific justification for such testing including an enumeration and description of precise tests including the extent to which the test will alter or destroy the evidence. In Castro the court denied the testing and concluded that scientific testing which destroys or materially alters evidence should be permitted only when required by the interests of justice. Not only has TW/Pacer failed to provide an adequate description of or necessity for the testing, their request is late coming well after the expiration of the factual discovery deadline.

This was never the parties' intention nor is it a fair application of the rules. To allow the extension would render meaningless the letter and spirit of the parties signed agreement and the court's order. Fact discovery was to be completed by April 21 followed by expert disclosures and then expert depositions. The parties also understood and agreed that expert depositions would not be conducted until all the parties produced expert reports and that the discovery schedule would be extended by agreement only if the timing of the final disposition of the case would not be affected. TW and Pacer understood that fact discovery included inspection and testing of the evidence but waited three months after the fact discovery deadline and two months after receiving plaintiff's expert reports to request additional testing. Because TW and Pacer have neglected their own disclosure deadlines the completion of expert discovery has already been delayed. TW/Pacer recently noticed the depositions of plaintiffs experts. This notice is yet another violation of the understanding among the parties that expert depositions would not be taken before expert reports were exchanged. Another tactical advantage resulting from the delay.

Plaintiff suspects that Mr. Geller has only recently been retained which explains this late request for an extension. If he had been promptly retained and had attended the testing and inspection he, like the other Third-Party expert, would have understood that plaintiff's experts were evaluating the crystal oscillator.[2] Plaintiff's expert report indicates that at the first

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[2] Pacer's reason for requesting the adjournment of the two scheduled evidence inspections was that Pacer employee Kevin Horton from Indiana was unavailable. There was never any mention of Mr. Geller, a local engineer.

inspection on April 5 observations regarding the integrity of the oscillator were made and were apparent to anyone who was present and observed the panel. On April 20 similar observations regarding the oscillator were made. The reason the defense did not realize the significance of the oscillator is because they failed to retain and/or involve a qualified expert in a timely fashion and the expert that they did have at the inspection apparently was not paying attention. The problem with the oscillator should surprise no one especially the TW/Pacer expert who was present at the inspection and testing.

Counsel is correct that Plaintiff is disappointed in the outcome of the mediation (the defense offered to settle this claim for little more than nuisance value after the parties incurred significant time and expense) but Plaintiff's objection to the further investigation is based upon the agreement that all parties made regarding discovery and an unwillingness to sustain additional expert expense and further delay.

TW and Pacer simply neglected to provide required expert reports by the discovery deadline. A party who disregards an expert disclosure deadline does so at its peril. TW and Pacer could have provided reports pending the Court's decision but did not and are now foreclosed from doing so. The Third Parties offer no compelling reason for the delay. The mere fact that a party or newly retained expert is curious about some piece of evidence is unpersuasive. The fact that that evidence has been inspected by the moving party on two prior occasions compels denial of the Motion. Plaintiff and BOC, the primary defendant against whom Plaintiff's expert will testify, produced their reports in a timely fashion and complied with all of the applicable deadlines and rules.

The TW/pacer request to extend the discovery deadline to allow for late notice of experts should be denied. In the Thibeault v. Square D Company, 960 F.2d 239 (1992) the United States Court of Appeals for the First Circuit discussed the issue of preclusion of experts who were identified late. While the facts of Thibeault are far more egregious than here and even suggest a pattern of inattention by the plaintiff's attorney in other cases, the court applies general principles of law that are applicable here. The trial Court has broad discretion in handling pretrial matters and its decisions will be given significant deference. In deciding whether or not to allow late notice of experts the court should evaluate several factors including the importance of the evidence to the proponent and the reason for the proponents failure to update discovery. A district court should consider all the circumstances surrounding the alleged violation. There , as

here, there was no good reason for the delay in identifying the expert. In addition there has been no showing that this testing and inspection is important to the defense. The Thibeault Court precluded the expert designations. Applying the rationale to the facts in this case destructive testing and late notice of experts should not be allowed.

It is important to remember that the defendant and Third-Party defendant are unified in their cause against the plaintiff. Denying the motion will not prejudice the Third-Party defendant relative to the plaintiff as they can still rely on the experts who will testify in behalf of the primary defendant.

Respectfully submitted,

COZEN O'CONNOR

By: s/ Peter G. Rossi

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- and-

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617-723-7770

Attorneys for Plaintiff

# EXHIBIT 1

UNITED STATES DISTRICT COURT
FOR THE DISTRICT OF MASSACHUSETTS

| | |
|---|---|
| DANA-FARBER CANCER INSTITUTE, INC. a/k/a THE JIMMY FUND<br><br>Plaintiff,<br><br>v.<br><br>BOC GROUP, INC. d/b/a BOC GASES<br>Defendant/Third-Party Plaintiff,<br><br>v.<br><br>TAYLOR-WHARTON, HARSCO CORPORATION, GAS & FLUID CONTROL GROUP and PACER DIGITAL SYSTEMS INC.<br><br>Third-Party Defendants. | Case No.: 04-CV-12612-RWZ |

**PROPOSED JOINT PRE-TRIAL SCHEDULE**

The parties in the above-referenced action have conferred and agree on the following schedule:

| | |
|---|---|
| Initial Disclosures of Plaintiff and Defendant/Third-Party Plaintiff by | April 15, 2005 |
| Initial Disclosures of Third-Party Defendants by | June 13, 2005 |
| Amendment to Pleadings by | July 18, 2005 |
| Joinder of Additional Parties by | August 12, 2005 |
| All Fact Discovery completed by | February 3, 2006 |
| Parties limited to 25 Interrogatories to other parties. Each party will be required to present up to eight fact witnesses for deposition. | |
| 26(b) Expert Disclosures, Plaintiff by | March 17, 2006 |
| 26(b) Expert Disclosures, Defendant/Third-Party Plaintiff by | May 1, 2006 |
| 26(b), Expert Disclosures, Third-Party Defendants by | June 15, 2006 |
| Plaintiff Expert Depositions completed by | August 1, 2006 |

| | |
|---|---|
| Defendant/Third-Party Plaintiff Expert Depositions completed by | September 15, 2006 |
| Third-Party Defendants Expert Depositions completed by | November 1, 2006 |
| Settlement Conference and/or ADR by | November 15, 2006 |
| Dispositive Motions Served by | December 1, 2006 |
| Responses to Dispositive Motions Served by | 40 days after service of motion |
| Dispositive Motions filed with Court by | January 10, 2007 |
| Final Pretrial | TBD |

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*/s/ Patrick J. Loftus, III*
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PATRICK J. LOFTUS, III, ESQUIRE
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617-723-7770

Counsel for Defendant, BOC Group, Inc. d/b/a BOC Gases,

*/s/ Matthew P. Sgro*
Michael P. Giunta
Matthew P. Sgro
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617-406-4500

Counsel for Third-Party Defendant, Taylor-Wharton, Harsco Corporation, Gas & Fluid Control Group,

*/s/ A. Damien Puller*
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617-345-1000

Counsel for Third-Party Defendant, Pacer Digital Systems, Inc.,

*/s/ David A. Barry*
David A. Barry
Anthony V. Agudelo
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617-227-3030

Dated: June 14, 2005



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# EXHIBIT 2

UNITED STATES DISTRICT COURT
FOR THE DISTRICT OF MASSACHUSETTS

| | |
|---|---|
| DANA-FARBER CANCER INSTITUTE, INC. a/k/a THE JIMMY FUND,<br><br>Plaintiff<br><br>v.<br><br>BOC GROUP, INC. d/b/a BOC GASES, Defendant/Third-Party Plaintiff<br><br>v.<br><br>TAYLOR-WHARTON, HARSCO CORPORATION, GAS & FLUID CONTROL GROUP AND PACER DIGITAL SYSTEMS INC.,<br><br>Third-Party Defendants | CASE NO.: 04-12612 RWZ |

## PROPOSED AMENDED JOINT PRE-TRIAL SCHEDULE

The parties in the above-referenced action have conferred and agree on the following schedule:

| | |
|---|---|
| Initial Disclosures of Plaintiff and Defendant/Third-Party Plaintiff by | April 15, 2005 |
| Initial Disclosures of Third-Party Defendants by | June 13, 2005 |
| Amendment to Pleadings by | July 18, 2005 |
| Joinder of Additional Parties by | August 12, 2005 |
| Fact Discovery Necessary for Settlement Discussions | December 2, 2005 |
| Status Report on Settlement | February 6, 2006 |
| All Fact Completed by | March 3, 2006 |
| Parties limited to 25 Interrogatories to other parties. Each party will be Required to present up to eight fact witnesses for deposition. | |
| 26(b) Expert Disclosures, Plaintiff by | April 3, 2006 |
| 26(b) Expert Disclosures, Defendant/Third-Party Plaintiff by | May 3, 2006 |
| 26(b), Expert Disclosures, Third-Party Defendants by | June 5, 2006 |

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Expert Discovery Completed by — September 29, 2006

Status Conference to Discuss Settlement And Other Pertinent Deadlines — October 12, 2006

Counsel for Plaintiff, Dana-Farber Cancer Institute a/k/a The Jimmy Fund,

/s/ Patrick J. Loftus

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/s/ Michael P. Giunta

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Counsel for Third-Party Defendants, Taylor-Wharton, Harsco Corporation, Gas & Fluid Control Group, and Pacer Digital Systems, Inc.

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617-345-1000

John J. Weinholtz
NIXON PEABODY LLP
Key Towers at Fountain Plaza
40 Fountain Plaza, Suite 500
Buffalo, New York 14202
716-853-8141

Dated: December 19, 2005

CERTIFICATE OF SERVICE
I certify that a true copy of this document was served upon ~~(each party appearing pro se and)~~ the attorney of record for each party by mail (hand) on December 19, 2005 and fax
(Signature)

B92321.1

# EXHIBIT 3

**Rossi. Peter**

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**From:** Rossi, Peter G. [mailto:PRossi@cozen.com]
**Sent:** Wednesday, March 08, 2006 2:03 PM
**To:** Weinholtz, John; Michael Giunta
**Subject:** RE: DFCI Depositions

John and Mike,
My expert will inspect and test the Pacer unit that is at the DFCI tentatively next Thursday starting at 10a.m. I will forward his planned protocol later today.
John, He has requested some additional information from Pacer including;

The GERBER files for the circuit board. They are typically software files with with names like 1.pho, 2.pho, 3.pho, drill.drl etc...
The actual PHOTOPLOTS or "Foils" used to make the board would be a reasonable substitute,
A better copy of the schematic,
A parts list for the controller,
Is the schematic that was sent a complete copy or are pages or sections missing,

Time is of the essence with this information. Please advise if the info will be produced. I believe that all of this information is included in our discovery request.

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# EXHIBIT 4

**Rossi, Peter**

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**From:** Weinholtz, John [JWeinholtz@nixonpeabody.com]
**Sent:** Thursday, March 09, 2006 12:05 PM
**To:** Rossi, Peter G.
**Subject:** RE: DFCI Depositions

I sent Pacer your e-mail and I am waiting to hear back from them. JOHN.

NIXON PEABODY LLP
ATTORNEYS AT LAW

John J. Weinholtz
Nixon Peabody LLP
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Buffalo, NY 14202
Office: 716.853.8141
Fax: 716.853.8109
jweinholtz@nixonpeabody.com
www.nixonpeabody.com



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**From:** Rossi, Peter G. [mailto:PRossi@cozen.com]
**Sent:** Thursday, March 09, 2006 11:08 AM
**To:** Weinholtz, John
**Subject:** RE: DFCI Depositions

John, Can they get me the requested docs?

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**From:** Weinholtz, John [mailto:JWeinholtz@nixonpeabody.com]
**Sent:** Wednesday, March 08, 2006 3:41 PM
**To:** Rossi, Peter G.; Michael Giunta
**Subject:** RE: DFCI Depositions

Peter: I haven't checked yet w/ Pacer as to their availability, but I am out of town on depositions next Thursday and Friday. I would be agreeable to extending your expert report time for some reasonable time. Can you get other dates from your expert? How much extra time do you think you would need? Please advise. JOHN.

John J. Weinholtz
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Key Towers at Fountain Plaza
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Buffalo, NY 14202
Office: 716.853.8141

# EXHIBIT 5

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UNITED STATES DISTRICT COURT
FOR THE DISTRICT OF MASSACHUSETTS

| | |
|---|---|
| DANA-FARBER CANCER INSTITUTE, INC. a/k/a THE JIMMY FUND, Plaintiff, v. BOC GROUP, INC. d/b/a BOC GASES, Defendant/Third-Party Plaintiff, v. TAYLOR-WHARTON, HARSCO CORPORATION, GAS & FLUID CONTROL GROUP AND PACER DIGITAL SYSTEMS INC., Third-Party Defendants | CASE NO.: 04-CV-12612-RWZ |

**STIPULATION**

It is stipulated and agreed by and between counsel for the plaintiff, defendant and third-party defendants that the time for the fact discovery and expert disclosures is extended as follows:

| | |
|---|---|
| Fact Discovery | April 21, 2006 |
| Plaintiff's 26(b) Disclosures | May 3, 2006 |
| Defendant's 26(b) Disclosures | June 5, 2006 |
| Third-Party Defendant's 26(b) Disclosures | July 5, 2006 |

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215-665-2783

Counsel for Defendant, BOC Group, Inc. d/b/a BOC Gases,

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617-406-4500

Counsel for Third-Party Defendant, Taylor-Wharton, Pacer Digital Systems, Inc.,

John J. Weinholtz
NIXON PEABODY LLP
100 Summer Street
Boston, MA 02110
617-345-1000

B96321.1

# EXHIBIT 6

**Rossi, Peter**

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**From:** Weinholtz, John [JWeinholtz@nixonpeabody.com]
**Sent:** Thursday, March 16, 2006 10:09 AM
**To:** Rossi, Peter G.; Michael Giunta
**Cc:** Matthew Sgro
**Subject:** Dana Farber v. BOC v. Taylor Wharton & Pacer
**Attachments:** Stipulation re Dana Farber.PDF

Pursuant to our telephone conversations of yesterday, I have modified the previously circulated stipulation to include an extended date for fact discovery, April 21, 2006, which should give us sufficient time to complete fact depositions. Also, that date falls before the extended expert disclosure dates that we previously agreed to (and which remain unchanged in the stipulation I am circulating).

Attached as a pdf is the Stipulation, which I have signed. Matt, I know Mike is out today. If you could print out the Stipulation and sign it on behalf of BOC, and then fax it to Peter Rossi, that would be great. Then Peter could sign it and take care of getting it filed. I know Peter is anxious to get this filed with the court. JOHN.

NIXON PEABODY LLP
ATTORNEYS AT LAW

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www.nixonpeabody.com

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# EXHIBIT 7

**Shanahan-Brown, Eileen**

| | |
|---|---|
| **From:** | Rossi, Peter G. |
| **Sent:** | Wednesday, March 22, 2006 12:08 PM |
| **To:** | Weinholtz, John; mgiunta@donovanhatem.com |
| **Subject:** | FW: Pacer-2L.PDF |
| **Attachments:** | Pacer-2L.PDF |

Pacer-2L.PDF
(14 KB)

Here is the test protocol. When do you want to take the deps? You will need an interpreter.

# 1. PURPOSE

The purpose of this document is to identify certain tests to be performed on the Pacer 2L Control System to aid in the analysis of the Pacer 2L Control System.

# 2. LIST OF EQUIPMENT

1. Pacer 2L Control System
2. Wide field of view magnifying glass, 4X magnification, or equivalent.
3. Loop or eyepiece, 10X magnification or equivalent.
4. Steel scale, 6 inches long, graded 1/10$^{th}$ inch, or equivalent
5. Digital multimeter (DMM), Fluke 75 or equivalent and Test Leads.
6. Test leads or wires for connecting to the Pacer 2L Control System.
7. Test Sensors used by manufacturer for verifying proper operation of the Pacer 2L Control System
8. Oscilloscope, 100 MHz, Tektronix model 465 or equivalent., optional.
9. Liquid nitrogen tank containing a sufficient supply of liquid nitrogen to operate the Pacer 2L Control for several cooling/heating cycles. Appropriate fittings, insulated hoses, adapters, connectors, et cetera to properly mate to the Pacer 2L Control System.
10. Personal Protection Equipment, PPE, as specified by OSHA for the safe handling of liquid nitrogen and/or cryogenic equipment.
11. Special Tool for reading the contents of the Pacer 2L log files without disturbing their contents.
12. Printer or equivalent device for reading log files out of a Pacer 2L Control, per manufacturer's recommended method.
13. A soft-copy and hard-copy of the operational source code for all programmable components of the Pacer 2L. The soft-copy shall include, at a minimum, the commented source code files, header files, "include" files, resource files, object files and target files.
14. A computer with appropriate software for viewing and searching through source code files. Suggested software: CodeWright, CodeWarrior, UltraEdit, Emacs or equivalent.

# 3. TEST AGENDA

## 3.1. VISUAL INSPECTION

3.1.1. Safety: Perform the following tests and observations without the power source connected to the Pacer 2L Control System.

3.1.2. Check equipment for regulatory agency certifications, stickers, markings or approvals.

3.1.3. Using the Digital Multimeter, check circuit traces for residual voltages.

3.1.4. Visually inspect both sides of the circuit board assembly for short circuits and solder bridges.

3.1.5. Record component part numbers, values, case sizes, reference designators, date codes and other component markings.

3.1.6. Determine grounding/shielding method employed for mitigation of the effects of Electrostatic Discharge, ESD, and Electromagnetic Interference, EMI.

3.1.7. Measure and record, track widths of copper circuit traces.

3.1.8. Measure and record, clearance from track to track.

3.1.9. Measure and record, clearance from track to edge of circuit board.

3.1.10. Measure and record, clearance from component to component.

3.1.11. Measure and record, clearance from components to circuit board features.

3.1.12. Inspect for workmanship, form, fit and finish.

3.1.13. Determine chassis wiring techniques employed.

3.1.14. Identify key components and circuit traces on the circuit board and correlate them with the supplied schematic.

3.1.15. Identify the method and components of "power-on reset" for the circuit board.

3.1.16. Annotate the schematic with missing information.

3.1.17. Inspect the temperature measuring sensor and associated mechanical mounting hardware.

3.1.18. Inspect the liquid nitrogen level measurement sensors and associated mechanical mounting hardware.

3.1.19. Inspect the dewar and cover seals.

3.1.20. Inspect the lid-monitoring switch and associated mechanical mounting hardware. Measure and record the actuation height, both "make" and "break", of the lid-monitoring switch. Measure and record over-travel distance of the switch assembly.

3.1.21. Measure and record information on other system components and sub-assemblies as they present themselves.

## 3.2. FUNCTIONAL TEST

3.2.1. Safety: Perform the following tests and observations without the liquid nitrogen source connected to the Pacer 2L Control System.

3.2.2. Attach the Test Sensors used by manufacturer for verifying proper operation of the Pacer 2L Control System, to the Pacer 2L Control.

3.2.3. Connect the 24VAC power supply to the Pacer 2L Control, per manufacturer's Operating Manual.

3.2.4. Adjust the Pacer 2L Control to maintain a dewar setpoint temperature of –180C.

3.2.5. Adjust the Thermal Test Sensor to indicate a dewar/chamber temperature of +25C.

3.2.6. Adjust the Test Sensors to approximate the liquid nitrogen level below the Low Alarm Level to simulate an Empty condition.

3.2.7. Measure the voltages present at various locations on the Pacer 2L circuit board. Record the voltage and location of measurement. Record any other indicators of system health as they present themselves.

3.2.8. Adjust the Test Sensors to approximate the liquid nitrogen level between Low Alarm Level and Low Level Setpoint.

3.2.9. Measure the voltages present at various locations on the Pacer 2L circuit board. Record the voltage and location of measurement. Record any other indicators of system health as they present themselves.

3.2.10. Adjust the Test Sensors to approximate the liquid nitrogen level between Low Level Setpoint and High Level Setpoint.

3.2.11. Measure the voltages present at various locations on the Pacer 2L circuit board. Record the voltage and location of measurement. Record any other indicators of system health as they present themselves.

3.2.12. Adjust the Test Sensors to approximate the liquid nitrogen level between High Level Setpoint and High Alarm Level.

3.2.13. Measure the voltages present at various locations on the Pacer 2L circuit board. Record the voltage and location of measurement. Record any other indicators of system health as they present themselves.

3.2.14. Adjust the Test Sensors to approximate the liquid nitrogen level above High Alarm Level to simulate an overfilled/overflow condition.

3.2.15. Measure the voltages present at various locations on the Pacer 2L circuit board. Record the voltage and location of measurement. Record any other indicators of system health as they present themselves.

3.2.16. Adjust the Thermal Test Sensor to indicate a dewar/chamber temperature of –55C.

3.2.17. Repeat steps 4 through 14.

3.2.18. Adjust the Thermal Test Sensor to indicate a dewar/chamber temperature of –170C.

3.2.19. Repeat steps 4 through 14.

3.2.20. Adjust the Thermal Test Sensor to indicate a dewar/chamber temperature of –180C.

3.2.21. Repeat steps 4 through 14.

3.2.22. Adjust the Thermal Test Sensor to indicate a dewar/chamber temperature of –190C.

3.2.23. Repeat steps 4 through 14.

3.2.24. Remove the Thermal Test Sensor to simulate an open circuit condition on the thermal feedback line.

3.2.25. Repeat steps 4 through 14.

3.2.26. Apply a short circuit to the thermal feedback connector on the Pacer 2L circuit board.

3.2.27. Repeat steps 4 through 14.

## 3.3. OPERATIONAL TEST

3.3.1. Safety: Perform the following tests and observations with the liquid nitrogen source connected to the Pacer 2L Control System.

3.3.2. Set the Control to maintain a dewar/chamber temperature of –180C.

3.3.3. Observe operation of the system.

3.3.4. Apply stimulii to the system and observe and record results.

## 3.4. SOURCE CODE REVIEW

I would like to have a copy of the source code on hand to help explain the characteristics of the microcomputer that cannot be determined from the schematic.

I am also requesting that a copy of the source code and other pertinent files be submitted to me to assist me in analyzing the numerical data collected during the tests.

# EXHIBIT 8

**Rossi, Peter**

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**From:** Rossi, Peter G.

**Sent:** Friday, March 24, 2006 10:53 AM

**To:** 'Weinholtz, John'; 'Michael Giunta'

**Subject:** RE: DFCI Depositions

John has just advised me that Pacer et al is unavailable for the inspection. We are agreeable (reluctantly) to postponing the inspection. My only concern is that we have not heard form the court regarding the stip to extend expert identifications. Can we all agree not to move to preclude any parties experts based upon late notice as long as we all comply with the dates in the stip?

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**From:** Rossi, Peter G.
**Sent:** Wednesday, March 22, 2006 11:13 AM
**To:** 'Weinholtz, John'; 'Michael Giunta'
**Subject:** RE: DFCI Depositions

Dear Counsel,
We are planning the panel inspection /test on March 29 at 10am at DFCI.

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# EXHIBIT 9

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**From:** Rossi, Peter G. [mailto:PRossi@cozen.com]
**Sent:** Tuesday, March 28, 2006 9:50 AM
**To:** Weinholtz, John
**Cc:** Michael Giunta; Matthew Sgro
**Subject:** RE: DFCI Depositions

John?

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**From:** Matthew Sgro [mailto:msgro@donovanhatem.com]
**Sent:** Tuesday, March 28, 2006 9:37 AM
**To:** Rossi, Peter G.; Weinholtz, John
**Cc:** Michael Giunta
**Subject:** FW: DFCI Depositions

I am available both the 5th and 6th for the inspection.

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**From:** Michael Giunta
**Sent:** Tuesday, March 28, 2006 9:15 AM
**To:** Matthew Sgro
**Subject:** FW: DFCI Depositions

Matt, are you available?

Michael

---

**From:** Rossi, Peter G. [mailto:PRossi@cozen.com]
**Sent:** Tuesday, March 28, 2006 9:09 AM
**To:** Rossi, Peter G.; Weinholtz, John; Michael Giunta
**Subject:** RE: DFCI Depositions

April 5 or 6 for the inspection/testing. Please let me know ASAP.

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# EXHIBIT 10

**Rossi, Peter**

**From:** Rossi, Peter G.
**Sent:** Friday, April 14, 2006 10:13 AM
**To:** 'mgiunta@donovanhatem.com'; 'JWeinholtz@nixonpeabody.com'
**Cc:** 'msgro@donovanhatem.com'
**Subject:** Re: DFCI Depositions

Mike and john, my experts will continue testing the panel next thursday 4/20 at jeff levine's facility. These will include the tests under power. The test protocol was complicated by the fact that the pacer schematic was incomplete. The testing will begin at 9 am. I will forward jeff's address.

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Sent from my BlackBerry Wireless Handheld

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'om: Rossi, Peter G.
:nt: Wednesday, March 22, 2006 11:13 AM

# EXHIBIT 11

NIXON PEABODY LLP
ATTORNEYS AT LAW

Key Towers at Fountain Plaza
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Fax: (716) 853-8109

John J. Weinholtz
Direct Dial: (716) 853-8141
E-Mail: Jweinholtz@nixonpeabody.com

June 19, 2006

Michael P. Giunta, Esq.
Donovan Hatem LLP
Two Seaport Lane
Boston, MA 02210

Peter G. Rossi, Esq.
Cozen O'Connor
1900 Market Street
Philadelphia, PA 19103

RE: Dana-Farber Cancer Institute, Inc. v. BOC Group, Inc. v. Taylor-Wharton, et al.
NP File No.: 082150.131

Dear Counselors:

Confirming my telephone conversations with both of you last week, you both have agreed to extend the Third-Party Defendants' time to serve their Rule 26 expert disclosures to and including July 21, 2006. Thank you for your courtesy and cooperation.

Very truly yours,

John J. Weinholtz

JJW/kl

10025571.1

# EXHIBIT 12

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ATTORNEYS AT LAW
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John J. Weinholtz
Direct Dial: (716) 853-8141
E-Mail: jweinholtz@nixonpeabody.com

June 30, 2006

**VIA FAX & U.S. MAIL**
Michael P. Giunta, Esq.
Donovan Hatem LLP
Two Seaport Lane
Boston, MA 02210

Peter G. Rossi, Esq.
Cozen O'Connor
1900 Market Street
Philadelphia, PA 19103

RE: Dana-Farber Cancer Institute, Inc. v. BOC Group, Inc. v. Taylor-Wharton, et al.
NP File No.: 082150.131

Counselors:

Attached is a protocol for further examination of the Mark 2L controller circuit board and crystal, which protocol has been prepared by Donald Galler, P.E., at MIT. Mr. Galler advises that items 1 through 5 can be done at his lab at MIT, but item 6 will have to be done off site. I will call next week to discuss dates for this examination.

Very truly yours,

John J. Weinholtz

JJW/kl
Encl.

10035986.1

# Protocol for Examination and Testing of Microprocessor Crystal
## Taylor – Wharton

1. Visual Examination and photograph of printed circuit (PC) board crystal mount area
2. Examine / photograph crystal lead solder joints on upper and lower surfaces of PC Board using stereo microscope
3. Unsolder crystal leads and remove crystal from PC board
4. Cut and remove plastic sleeving from crystal
5. Examine crystal lead attachments in Scanning Electron Microscope
6. X-ray radiograph crystal using real time microfocus x-ray (offsite)

# EXHIBIT 13

April 21, 2006

James A. Karon
48 Court Street
Medford, MA 02155
j.a.karon@ieee.org

Mr. Peter G. Rossi, Esquire
Cozen O'Connor
1900 Market Street
Philadelphia, PA 19103

Reference: Dana Farber Cancer Institute, Cozen O'Connor File Number 132369
Dana Farber v. BOC

Dear Mr. Rossi,

I was asked to investigate a liquid nitrogen cryogenic freezer failure that was discovered at the Dana Farber Cancer Institute (DFCI), Thomas Roberts Laboratories, on or about August 15, 2002. I was asked to answer eight specific questions pertaining to the Taylor Wharton 10K liquid nitrogen cryogenic freezer. I was asked to determine how and/or why did the Taylor Wharton 10K liquid nitrogen cryogenic freezer fail in August of 2002. I was also asked to determine if a specific blown capacitor would have caused the symptoms observed by DFCI employees including the failure of the digital readout to change, failure of the automatic fill to operate properly, failure of the manual fill to operate properly and failure of the alarms to activate. I was asked to determine if it is possible the failures observed by DFCI employees and others were a result of the Taylor Wharton 10K liquid nitrogen cryogenic freezer's display indicating a cryogenic condition within the cryogenic freezer. I was also asked to determine if the catastrophic failure could have been avoided if DFCI had made use of the Taylor Wharton 10K liquid nitrogen cryogenic freezer's external alarm connector. I was also asked to determine if the external alarm operates off the same circuit as the internal alarm and would the external alarm had activated if the Taylor Wharton 10K liquid nitrogen cryogenic freezer was registering cryogenic conditions on its display module. I was asked to determine if BOC was negligent when it sent a salesman instead of a service man to respond to a trouble call. I was asked to determine if Bill Emmett did everything that was reasonable to determine the status of the freezer and should he have changed the Taylor Wharton 10K liquid nitrogen cryogenic freezer's control panel. And lastly, I was asked to determine if Dana Farber acted reasonably in following the instructions of BOC.

The Taylor Wharton 10K CryoStorage System with Mark 2L Controller is a freezer that is, according to the Taylor Wharton's 10K manual, "designed for applications where extremely low temperature storage of biological products is required." The Taylor Wharton CryoStorage System with Mark 2L Controller consists of a dewar and an electronic control panel that automatically regulates the application of liquid nitrogen. The dewar itself is a double walled vessel where a near vacuum exists between the sealed inner and outer walls. This technology was invented by Scottish physicist Sir James Dewar in 1892. A German company, named Thermos GmbH, made the first commercial dewar vessels around 1904. Since then, we have adopted their trade name "Thermos" to mean a generic dewar or vacuum flask. The operating principle of the dewar is based on the vacuum that exists between inner and outer walls and the reflective surfaces of these walls. This vacuum provides the dewar with its insulating properties. Heat cannot be efficiently transferred through a vacuum by convection or conduction, and the internal reflective walls help reduce the radiated heat transfer. The center section of the dewar is designed to hold the items that one wishes to control the temperature of. Since no dewar is perfect, items placed within a dewar will eventually change temperature. A cryogenic refrigerator, such as the Taylor Wharton CryoStorage System with Mark 2L Controller, combines the insulating properties of the dewar with the cooling ability of liquid nitrogen and the control ability of the Pacer 2L Control Panel. The Mark 2L electronic liquid level controller monitors and controls the supply of liquid nitrogen to the dewar, according to the Taylor Wharton 10K manual. The reason that this is important is because, unlike a Thermos bottle which is used to maintain the temperature of the items placed within it, the Taylor Wharton 10K CryoStorage System with Mark 2L Controller actually cools the items placed within the dewar through the application and regulation of liquid nitrogen. Liquid nitrogen, itself, has a temperature of approximately –196C, and the gaseous layer of nitrogen above the liquid is slightly warmer, but can still be in the cryogenic range of -150C and below. The Mark 2L Control panel has sensors that extend into the storage area of the dewar to help monitor and regulate the level of liquid nitrogen within the dewar. The Mark 2L Control is designed to, among other things, add liquid nitrogen to the dewar when it determines that the liquid nitrogen has fallen below the low level set point of the corresponding sensor. The Mark 2L Control also uses the sensors that extend into the dewar to determine when enough

liquid nitrogen has been added to the dewar to reach the predetermined high level set point. The Mark 2L Control panel is designed to continually monitor and maintain the liquid nitrogen level between these two sensor set points, i.e. high level and low level. Two other sensors are also continually monitored by the Mark 2L Control panel, these are the high alarm sensor and the low alarm sensor. As their names indicate, the high alarm sensor and the low alarm sensor are used by the Mark 2L Control panel to sense when the measured level of liquid nitrogen is either too high or too low and as a result of this level being too high or too low the alarms of the Mark 2L Control panel become activated.

Background information was obtained through review of the following materials:

Operating Instructions for the Pacer 2L Control System, Exhibit Greene-7

Operating and Maintenance Instructions 10K, 24K and 38K CryoStorage Systems with Mark 2L Controller, Taylor-Wharton, Exhibit Wimberly-2

Electrical Schematic Diagram, Pacer Digital Systems, Inc., PDS00179

Report on the Mark 2L Control Panel

Time and Temperature log, 2902TMP, PDS00107

Email Exhibit Greene-3

Incident Report for LN2 Freezer Failure, Dana Farber

Email Exhibit Wimberly-12

Video Test #1, 082150/000131, Dana Farber v. Sherwood

Video Test #2, 082150/000131, Dana Farber v. Sherwood

Various emails, repair notes and numerous deposition transcripts

In addition to reviewing the background materials, I had two opportunities to test the physical Mark 2L Control Panel electronics assembly, serial number 2902. Once on April 5, 2006 where I first performed a visual inspection of the Mark 2L Control Panel and its assembly and then disassembled the Mark 2L Control Panel to allow access to the electronic circuit card assembly. The second opportunity to test the Mark 2L Control Panel was on April 20, 2006. For this second test, I brought additional equipment to offer me greater insight into the Mark 2L Control Panel's performance and design. On both occasions, the following people were present in the room while I performed my tests: Mr. Jeffrey Levine, Mr. Kevin Horton,,Ms. Tracey Ehrlers and Mr. Matt Sgro.

In regards to the evidence that was supplied to me, I would like to emphasize the poor quality and condition of the Electrical Schematic Diagram, Pacer Digital Systems, Inc., PDS00179. The schematic diagram is in such poor condition that some component values, pin numbers and reference designators were illegible. Even when aided with a 4-power magnifying glass and a 10-power magnifying loupe, the information could still not be discerned. An additional hindrance in the circuit analysis was that an official Bill Of Materials was not produced for the Mark 2L Control Panel. The Bill of Materials would have allowed for correlation between the "as-designed" Mark 2L Control Panel and the "as-built" Mark 2L Control Panel.

As a result of my testing on April 5, 2006 several discrepancies in the Electrical Schematic Diagram, Pacer Digital Systems, Inc., PDS00179, were found and listed as follows:

***Observation 1.*** Voltage regulator, VR1, is shown on the schematic as a 7805 –style regulator when it is actually a 78L05 –style regulator. Even though the two parts have similar sounding part numbers, their physical size, construction and pin assignments are different.

***Observation 2.*** Connector, CON5, is shown on the schematic as a 5-pin connector, it is actually a 6-pin connector. Only five of those six pins are displayed on the schematic.

***Observation 3.*** Capacitor, C3, is shown on the schematic as a 330uF/25V, it is actually a 470uF/25V

***Observation 4.*** The analog thermocouple signal conditioning circuit, including at least two sections of quad-amplifier IC17 have been rewired and do not match the schematic.

***Observation 5.*** The voltage regulator circuit, consisting of components IC23, L2, D7, C4 and other circuit elements, is missing from the schematic. By tracing the circuit board traces I was able to determine that this voltage regulator circuit forms a positive power supply that provides regulated electrical power to the Level Sensor signal conditioning circuit whose components include IC15, IC18, IC19, various resistors, various diodes.

*Observation 6.* The voltage regulator circuit, consisting of components IC22, L1, D8, C5 and other circuit elements, is missing from the schematic. By tracing the circuit board traces I was able to determine that this voltage regulator circuit forms a negative power supply that provides regulated electrical power to the Thermocouple signal conditioning circuit, the Chart Recorder drive circuit and the Thermocouple Digitizing circuit whose components include IC10, IC11, IC17, various resistors, various diodes.

*Observation 7.* The Power-On Reset and Watchdog Timer circuit, which consists of the integrated circuit IC4, is missing from the schematic.

Additional observations were made on April 5, 2006 several that have bearing on the overall quality of the Mark 2L Control Panel.

*Observation 8.* Connector, CON9, is an unpolarized connector that is used to interface to the display portion of the schematic via a polarized mating connector. Pin 1 of connector, CON9, is mislabeled on the circuit board, by means of a square solder pad, since it does not match the pin 1 of its mating connector. The square pad is the universally accepted indicator for pin 1 on "through-hole" electrical components.

*Observation 9.* The microprocessor's crystal, XTAL, was not mounted securely to the Mark 2L Control Panel circuit board. Instead, the crystal was supported mechanically by the wires used for its electrical connection. This method places extra mechanical stress on the hermetic seal that the crystal requires for reliable operation. Loss of hermetic seal on crystal devices of this type can lead to premature failure. Loss of hermetic seal is exacerbated by the shipping and handling of the Mark 2L Control Panel. Mechanical vibration and or resonances brought on by normal shipping and handling can crack the hermetic seal and can lead to reduced reliability of the crystal oscillator circuit in the Mark 2L Control Panel.

*Observation 10.* A small and uneven amount of thermal grease was applied to the top of two Shindengen Electric DC-DC Converter modules, MOD1 and MOD2. Thermal grease is typically applied in thin, even coats to improve heat conductivity between two objects. In the Mark 2L Control Panel, the thermal grease was used to distribute the excess heat generated by MOD1 and MOD2 to the upper aluminum plate of the Mark 2L Control Panel Assembly. On this Mark 2L Control Panel, the heat transfer from MOD1 and MOD2 is diminished by the poorly applied thermal grease.

*Observation 11.* The Mark 2L Control Panel circuit board had fingerprints and palm prints evident in the conformal coating. This indicates that the circuit board was handled before the conformal coating was cured. Conformal coating is applied to circuit boards to mitigate the effects of contamination due to environmental and other conditions. By handling the board before the conformal coating has cured removes conformal coating material by transfer from the circuit board to the hand of the person touching the board. This compromises the integrity of the conformal coating and reduces its effectiveness.

*Observation 12.* A circuit board design rule violation was discovered in two locations beneath capacitor, C3. The design rules violations can be easily seen near the center of photographs PDS00174 and PDS00175. In both cases, a circuit board feature, known as a via, is located beneath the metal case of capacitor, C3. Through normal operation and ambient temperature fluctuations, the metal case of the capacitor can short circuit to either one or both of the vias. During my inspection of the Mark 2L Control Panel circuit board, I was able to correlate each via to a circuit component that can be located on the schematic diagram, PDS00179. One offending via belongs to a circuit that travels from pin 4 of power connector, CON2, to pin 15 of integrated circuit, IC2. The Mark 2L Control Panel schematic diagram does not show the connection between these two items, yet the connection exists. This is another example of where the schematic, PDS00179, does not agree with the Mark 2L Control Panel Assembly. The second via that violates the design rules was traced back to the negative power supply pin of the analog thermocouple signal conditioning circuit. A short circuit between this via and the metal case of the capacitor, C3, would force the negative power supply of the analog thermocouple signal conditioning circuit to zero volts, thus causing a malfunction of the temperature measurement circuit and the chart recorder drive circuit, since both these circuit share the same negative power supply.

On April 20, 2006, I performed electrical tests on the Mark 2L Control Panel, serial number 2902. The following people were present in the room while I performed my tests: Mr. Jeffrey Levine, Mr. Kevin Horton, Ms. Tracey Ehrlers and Mr. Matt Sgro. During the equipment set-up portion of the test, Mr. Kevin Horton offered that the Test Sensors used by the manufacturer for verifying proper operation of the Mark 2L Control Panel, item 7 of my test agenda's List of Equipment, did not exist. In an effort to complete my tests in a timely fashion, I configured four simulated level sensors using the guidelines shown on page 18 of the Taylor-Wharton Operating and Maintenance Instruction, identified as TW-290A,

factory code number 7950-8290 and also as Exhibit Wimberly-2. I used four potentiometers with an adjustment range from less than 1 Ohm to greater than 95,000 Ohms to simulate typical level sensors. The four potentiometers were wired into the Mark 2L Control Panel using standard AWG 26 insulated hook-up wire and specialty wire manufactured by Berg. The specialty wire comes with connector sockets pre-wired every 6 inches. These connector sockets were designed for mating to the Level Sensor connector, CON5, of the Mark 2L Control Panel. A type-T thermocouple was connected to the Mark 2L Control Panel at connector, CON7. Mr. Jeffrey Levine supplied liquid nitrogen in a double insulated cup that was used to chill the type-T thermocouple down to cryogenic temperatures. Mr. Levine refilled the double insulated cup when requested to do so, to maintain continuity of test measurements. With the type-T thermocouple immersed in liquid nitrogen, and the four potentiometers connected to the Mark 2L Control Panel in place of the Level Sensors, I was able to begin testing. As a result of my testing on April 20, 2006, the following observations were made and anomalies noted.

*Observation 13.* An anomaly was noticed the very first time I applied power to the Mark 2L Control Panel through a variac and 24VAC transformer. As I slowly increased the voltage level, using a variac, from 0 % to 100%, the Mark 2L Control Panel failed to start. The 5 Volt digital power supply was working correctly, the front panel display was illuminated, yet there was no indication of microprocessor activity. This is a strange condition to be in, the power supplies were functioning correctly, yet the Mark 2L Control Panel was not performing its power-on initialization routine. After approximately one minute of inactivity from the Mark 2L Control Panel, I reduced the input voltage level from 100% to 0%.

*Observation 14.* The second time I applied power to the Mark 2L Control Panel using the variac, I increased the voltage level from 0% to 100% in less than one-half second. This time the Mark 2L Control Panel performed its power-on initialization in a fashion consistent with the manufacturers operating manual. The "Power Fail" alarm condition was sounded and the red status LED was blinking, as expected.

*Observation 15.* An anomaly was noticed when I short circuited the High Level Sensor potentiometer, the Mark 2L Control Panel did not indicate a shorted sensor, as described in the Taylor-Wharton Operating and Maintenance Instruction Manual.

*Observation 16.* An anomaly was noticed when I short circuited the Low Level Sensor potentiometer, the Mark 2L Control Panel did not indicate a shorted sensor, as described in the Taylor-Wharton Operating and Maintenance Instruction Manual.

*Observation 17.* An anomaly was noticed when I set the High Level Sensor potentiometer to approximately 23K Ohms, the Mark 2L Control Panel indicated an "open circuit" sensor alarm. According to the Taylor-Wharton Operating and Maintenance Instruction Manual, 23KOhms should have been interpreted as an "in liquid nitrogen" condition. According to the manual, the open circuit alarm threshold occurs when the resistance is above 50KOhms. From my understanding of the Mark 2L Control panel, this indicates a serious failure in the Mark 2L Controller's liquid nitrogen level measurement circuitry. It means that this Mark 2L Control panel cannot tell the true conditions surrounding the High Level Sensor, in other words, when the microprocessor monitors the High Level Sensor, it will receive a false indication of the liquid nitrogen level at the High Level Sensor from the circuit on the Mark 2L Control panel that monitors the High Level Sensor.

*Observation 18.* I adjusted the High Alarm Sensor potentiometer until an "open circuit" alarm was indicated by the Mark 2L Control Panel. I made note of the potentiometer position and subsequently measured its resistance. It measured 71K Ohms, which is consistent with the Taylor-Wharton Operating and Maintenance Instruction Manual.

*Observation 19.* I adjusted the Low Alarm Sensor potentiometer until an "open circuit" alarm was indicated by the Mark 2L Control Panel. I made note of the potentiometer position and subsequently measured its resistance. It measured 77K Ohms, which is consistent with the Taylor-Wharton Operating and Maintenance Instruction Manual.

*Observation 20.* I adjusted the Low Level Sensor potentiometer until an "open circuit" alarm was indicated by the Mark 2L Control Panel. I made note of the potentiometer position and subsequently measured its resistance. It measured 73K Ohms, which is consistent with the Taylor-Wharton Operating and Maintenance Instruction Manual.

*Observation 21.* An anomaly was noticed when I rapidly adjusted the High Level Sensor potentiometer from approximately 100K Ohms to approximately 0 Ohms, the Mark 2L Control Panel indicated a "Power Fail" alarm instead of an "open circuit" sensor alarm or short circuited sensor alarm.

April 21, 2006

At this point, I reduced the input voltage, using a variac, from 100% to 0%. As a safety precaution, I removed power from the Mark 2L Control Panel while I removed several screws to allow access to the circuit board components. Utilizing oscilloscope probes, mini-grabber test leads, micro-grabber test leads and several chip-clips, I was able to instrument the Mark 2L Control Panel.

*Observation 22.* I monitored the crystal oscillator drive pin of the microprocessor with an HP5315 Universal Counter. With the Mark 2L Control Panel in operational mode, I measured between 7.998 MHz and 8.000 MHz.

*Observation 23.* I monitored and recorded the waveform present on capacitor, C1. The measurements that I made shows a repetitive sawtooth signal measuring 11 Volts peak to peak; a positive slope (charge-time) time of about 2 ms and a negative slope (discharge-time) of about 16.4 ms.

*Observation 24.* I monitored and recorded the waveform repetition period of the watchdog signal that was present at pin 6 of IC4, the ADM705AN power on reset chip. A period of approximately 16 ms was seen on the oscilloscope, with numerous transitions within this 16 ms period. The number of watchdog signal transitions was estimated at more than 100 transitions. The watchdog signal transitions, if evenly spaced, would occur approximately once every 160 microseconds. Typically one designs a watchdog circuit to transition or "tickle the watchdog" at a periodic rate that is about 20% to 80% of the watchdog timeout period. For the ADM705AN power-on reset chip, one would typically design the "tickle" to occur once every 200 ms to 800 ms. This is not an actual design rule, but application notes for this device and other similar watchdog timers mention that the effectiveness of the watchdog is better served by operating in this fashion.

*Observation 25.* I simulated a normally operating Mark 2L Control Panel by adjusting the Level Sensor potentiometers to indicate a normal cryogenic condition. I adjusted the Sensors to call for liquid nitrogen, and the Mark 2L Control Panel display responded by changing from the message "O.K." to the message "FILL". The digital voltmeter that I had connected to the liquid nitrogen valve terminals of connector CON1, measured the liquid nitrogen valve voltage as 23.8 Volts.

*Observation 26.* I adjusted the Sensors to indicate that the freezer had acquired the proper liquid nitrogen level, and the Mark 2L Control Panel display responded by changing from the message "FILL" to the message "O.K.". The digital voltmeter that I had connected to the liquid nitrogen valve terminals of connector CON1, measured the liquid nitrogen valve voltage as 3.45 Volts.

*Observation 27.* I removed the type-T thermocouple from its liquid nitrogen bath and allowed the thermocouple to warm up to ambient conditions. The High Temperature Alarm was triggered when the Mark 2L Control Panel measured a temperature of –100C, as stated in the manual.

*Observation 28.* I returned the type-T thermocouple to the liquid nitrogen bath and allowed the temperature to settle at the cryogenic condition of –194C. The Mark 2L Control Panel updated the display module with a reasonably correct indication of the thermocouple temperature.

*Observation 29.* I performed a defective oscillator simulation by overriding the oscillator input at pin 1 of IC1. Immediately, the watchdog timer input at pin 1 of IC4 stopped toggling, as witnessed by the oscilloscope display. Also at this time, the front panel display of the Mark 2L Control Panel did not indicate a catastrophic failure of the crystal oscillator circuit. Furthermore, the thermocouple probe was removed from its liquid nitrogen bath and allowed to warm up to ambient room temperature, yet the Mark 2L Control Panel did not indicate any temperature change at all. The display was still reading –194C, the display still indicated 6 inches of liquid nitrogen and the display still indicated an "O.K." condition. Furthermore, I adjusted all the Level Sensor potentiometers past their open circuit alarm threshold, yet the Mark 2L Control Panel did not indicate any sensor failure. I then adjusted each of the Level Sensor potentiometers to less than 5 Ohms and the Mark 2L Control Panel did not indicate a short-circuited sensor condition, the display was still reading –194C, the display still indicated 6 inches of liquid nitrogen and the display still indicated an "O.K." condition. The manual fill button did not activate the manual fill circuitry. Since the microprocessor's oscillator was not working, and since all functionality of the Mark 2L Control Panel is controlled by the microprocessor the manual fill button could not work. Furthermore, since actuation of the liquid nitrogen valve is also controlled by the microprocessor, the liquid nitrogen valve could not work. In addition, since the display module only displays the information that the microprocessor sends to it, the display module could not alter the information that had previously been sent to it. Therefore, when the crystal oscillator ceases to function, the microprocessor ceases to function. Even though there is a power-on reset chip with built-in watchdog timer, and even though the watchdog timer circuit is attempting to reset the microprocessor, the microprocessor cannot perform the reset because the microprocessor requires the crystal oscillator to be functioning properly in order to perform the instructions it has programmed with. Digital microprocessors execute a set of software instructions in a sequential fashion. The speed at which the microprocessor operates on the software instructions is generally called its clock rate or clock speed. The crystal is the part of the oscillator circuit that defines the clock rate. The crystal is a electromechanical device that is analogous to a pendulum. Where a pendulum set the time-base in a grandfather clock, the crystal sets the time base in a crystal oscillator circuit. In the case of the Mark 2L Control panel, the crystal was oscillating or vibrating at approximately 8 MHz or 8 million times per second or 8 mega Hertz. The design of the Mark 2L Control panel's microprocessor is similar to most microprocessors in that they depend on a stable clock rate to perform the software instructions at a consistent and known rate. Many calculations of the Mark 2L control panel depend on the know oscillating frequency of the crystal. Other components on the Mark 2L Control panel also depend on the clock rate established by the crystal oscillator. Crystal oscillators, when properly designed can provide years of reliable service. Unfortunately crystal oscillators are susceptible to a variety of environmental effects which requires them to be protected from these detrimental effects. One way in which the crystals are protected is that the crystal manufacturer supplies them in a vacuum sealed container. A weak point for many crystals is in the transition seal region where the wires required for electrical contact to the crystal have to protrude from the case of the crystal assembly. It is relatively easy to break the seal and inadvertently expose the crystal to among other things dirt, dust and humidity due to loss of seal. Careful handling of the crystals is required to prevent breaking this seal. The Mark 2L controller uses the crystal's electrical connections as its mechanical support which puts extra stress on the seal of the crystal, especially during transport, such as shipping and elevators, rolling over floor imperfections such as thresholds etc. Crystal failure is a common and well known problem in the electronics industry.

It was reported that circa July 2002, Ole Gjoerup tried manual fill button on the Mark 2L Control Panel, but the manual fill button didn't work and the display was not changing.

It was reported that on August 2, 2002, Jean Zhao tells Witten that Midori finds the manual fill button not working on the Mark 2L Control Panel. It is also reported by Jean Zhao that the panel always was reading 6" and -131C and that these same numbers were displayed in days prior to Aug. 2, 2002.

It was reported that on August 15, 2002, Ole Gjoerup touched the vials with his bare hands and found them at room temperature. In addition, Midori reported that the refrigerator was warm and dry, but the Mark 2L Controller's display module read 6" and -160C.

## Conclusions

The following conclusions are based on information reviewed to date, the testing performed on the Mark 2L Control Panel on April 5, 2006, the testing performed on the Mark 2L Control Panel on April 20, 2006, the author's education and

experience. The conclusions are subject to change in the event that additional information is obtained. Based on the above investigation and analysis, I conclude the following, to a reasonable degree of certainty:

*Conclusion 1.* On the question of "how and/or why did the Taylor Wharton 10K liquid nitrogen cryogenic freezer fail in August of 2002", I can conclude that the freezer failure could only be caused by a defective Mark 2L Control Panel. I made this conclusion by logically ruling out all other possibilities and by testing and inspecting the Pacer 2L Control panel, serial number 2902. The Mark 2L Control Panel is designed in such a manner that it can detect many common system failures, but not all system failures. Had this Mark 2L Control Panel been working properly, it would have detected and provided a visual alarm, an audible and an status message on the user display indicating the type of failure it detected. In this case, no such alarms were activated. In this case, the display portion of the Mark 2L Control Panel continued to indicate a cryogenic condition within its freezer at a time when the true temperature within its freezer was clearly non-cryogenic.

*Conclusion 2.* On the question of "would a blown capacitor, C3, have caused the symptoms observed by DFCI employees including the failure of the digital readout to change, failure of the automatic fill to operate properly, failure of the manual fill to operate properly and failure of the alarms to activate?" I conclude that a failure of capacitor C3, alone, could not have caused all the symptoms observed by DFCI employees, but it may have been a contributing factor. Since the actual defective capacitor C3 was discarded after it was removed from serial number 2902 Mark 2L Control Panel, I did not have the opportunity to evaluate its condition. Capacitor C3 is one of the main storage capacitors that filters the +5Volt power bus to the digital logic circuitry of the Mark 2L Control Panel and several other components. Some of the key components that use this +5Volt power bus include the microprocessor, the user display, the 8255 Programmable Peripheral Interface and the power-on reset chip with built-in watchdog timer. Failure modes for capacitor C3 to consider are, short circuit, open circuit and out-of-spec capacitance.

A short circuited capacitor C3 will prevent the +5Volt digital power bus from achieving a voltage level capable of operating the Mark 2L Control Panel digital electronics. That means that the display module will remain blank, because the display module requires +5Volts ±10% for proper operation. This also means that the microprocessor circuit will not operate either, for the same reason. Since it was reported that the display was operating normally then capacitor C3 did not fail in this manner.

If instead, capacitor C3 fails in the open circuited condition, then excessive ripple due to lack of filtering will occur on the +5Volt digital power bus. This excessive ripple will be recognized by the power-on reset chip, which has an activation threshold voltage of +4.65Volts, according to the manufacturer's data sheet. The power-on reset chip will subsequently force the microprocessor to reset and after a finite amount of time, the power-on reset chip will allow the microprocessor to re-start its program from the beginning. The video evidence clearly shows the Mark 2L Control Panel in a seemingly endless loop of starting and then re-starting itself over and over again. Since this type of erratic behavior of the Mark 2L Control Panel was not reported by DFCI personnel, it is logical to conclude that capacitor C3 did not fail in this open circuit mode.

If instead, capacitor C3 fails in an out-of-spec mode, different symptoms may arise. The typical tolerance for a general purpose electrolytic capacitor is value ±20% to +80%/-20% . Some special purpose electrolytic capacitors may be specified differently, but the majority of electrolytics fall within this tolerance range. In the Mark 2L Control Panel +5Volt digital power circuit, a capacitance value larger than the specified value will operate without any detrimental effects. Therefore we need to be concerned when the capacitance falls below the specified range.

> **Scenario 1.** As the capacitance of C3 gradually decreases, the ripple voltage or fluctuating portion of the voltage increases. As the ripple voltage increases from near zero volts (ripple) to 0.7 Volts peak to peak (ripple), the low point voltage that will be measured on the +5Volt digital power bus will approach the +4.65Volt threshold of the power-on reset chip. Once this threshold is breached for approximately 2 microseconds, the power-on reset chip will force the microprocessor into the reset state and after a finite amount of time, the power-on reset chip will allow the microprocessor to re-start its program from the beginning. If capacitor C3 failed in this manner, the ripple voltage would have repeatedly triggered the power-on reset chip, thus perpetually forcing the microprocessor to remain in its reset state. If, in the moments prior to the initial triggering of the power-on reset chip, the microprocessor had read the thermocouple temperature and updated the display module with the actual cryogenic temperature in the freezer, the display module would have retained this cryogenic reading indefinitely. The display module would have remained indicating a cryogenic condition until the power was removed from the Mark 2L Control Panel or until the ripple voltage increased to the point where it started affecting the display module. In addition, since the microprocessor is in the reset condition, the front panel pushbutton will be ignored and the autofill mechanism will cease to function normally.

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Scenario 2. As the capacitance of C3 gradually decreases, the ripple voltage or fluctuating portion of the voltage increases. As the ripple voltage increases from near zero volts (ripple) to 0.7 Volts peak to peak (ripple), the low point voltage that will be measured on the +5Volt digital power bus will approach the +4.65Volt threshold of the power-on reset chip, but the waveform produced by the Shindegen DC-DC Converter module is less than the 2 microsecond minimum time required to trigger the power-on reset chip. In this scenario, the capacitor continues to degrade and the ripple voltage continues to increase. As the ripple voltage increases to 1.0 Volts peak-to-peak, the lowest part of the voltage waveform approach 4.5 Volts, which is the minimum operating voltage for many digital integrated circuits including the microprocessor and the memory. Once the minimum operating voltage for the microprocessor is breached, the microprocessor can behave in an unpredictable fashion. Once the microprocessor's minimum operating voltage level has been breached, one cannot reliably predict the results to any degree of certainty.

*Conclusion 3.* On the question of "is possible that the failures observed by DFCI employees and others were a result of the Taylor Wharton 10K liquid nitrogen cryogenic freezer's display indicating a cryogenic condition within the cryogenic freezer." I conclude that the failures observed by DFCI employees and others can only be a result of the Taylor Wharton 10K liquid nitrogen cryogenic freezer's display indicating a cryogenic condition within the cryogenic freezer when a cryogenic condition did not actually exist within the freezer. The reasoning behind this is relatively simple. The Taylor Wharton 10K liquid nitrogen cryogenic freezer system consists of very few subassemblies. The major subassemblies include the dewar body, the dewar lid, the Mark 2L Control Panel, the liquid nitrogen solenoid valve, the type-T thermocouple, the quad Level Sensor assembly, a liquid nitrogen tank, interconnecting tubing.

Below I have listed the symptoms that were reported, in a condensed format,

The display module does not change its display readings from some time in July 2002 to August 8, 2002. Those readings were –131C and 6 inches of liquid nitrogen, as reported. Manual pushbutton does not work.

Between August 8, 2002 and August 15, 2002 the display module does not change its readings. One witness reported that the display read –160C and 6 inches of liquid nitrogen, the other witness reported that the display read –130C and 6 inches of liquid nitrogen. In both reports, the Mark 2L Control Panel was reporting a cryogenic condition within the freezer.

The logic that leads me to make my conclusion is that only subassembly in the Taylor Wharton 10K liquid nitrogen cryogenic freezer system that had control of the liquid nitrogen level and had control of the display module and had control of the manual fill pushbutton was the Mark 2L Control Panel.

I am able to rule out the dewar body as the culprit, because a dewar failure is accompanied by condensation and/or frost on the outside surface of the dewar body that would have been visible to the DFCI employees and others. In addition, the dewar body has no means of causing the manual fill button lose functionality. The dewar body has no means of preventing a high temperature alarm or any alarm from being displayed on the display module. The dewar body has no means of preventing the red alarm indicator on the front panel from illuminating during a high temperature alarm or any alarm condition. The dewar body has no means of preventing the audible alarm annunciator from sounding during a high temperature alarm or any alarm condition. Furthermore, a dewar body failure would make it more difficult for the Mark 2L Control Panel to maintain a stable temperature for such a long period of time.

I am able to rule out the dewar lid as the culprit, for the same reasons as the dewar body. The dewar lid has no means of causing the fill button lose functionality. The dewar lid cannot suppress any of the alarm indicators or alarm annunciator.

I am able to rule out the liquid nitrogen valve as the culprit since it has no means of causing the manual fill button lose functionality. The liquid nitrogen valve cannot suppress any of the alarm indicators or alarm annunciator.

I am able to rule out the type T thermocouple as the culprit since it has no means of causing the manual fill button lose functionality. The type T thermocouple cannot cause the display module to display an incorrect level of liquid nitrogen. The Mark 2L Control panel was designed with the ability to detect a missing or open circuited thermocouple.

I am able to rule out the quad Level Sensor assembly as the culprit since it has no means of suppressing any of the alarm indicators or alarm annunciator. The quad Level Sensor cannot cause the display module to indicate an incorrect temperature within the freezer.

I am able to rule out the liquid nitrogen tank and interconnecting tubing as the culprits as they have no means of suppressing any of the alarm indicators or alarm annunciator. The liquid nitrogen tank and interconnecting tubing cannot

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cause the display module to indicate an incorrect temperature within the freezer and they cannot cause the display module to indicate the incorrect level of liquid nitrogen within the freezer.

I cannot rule out the Mark 2L Control Panel as it has direct control over the manual fill button. The Mark 2L Control panel also has direct control over what temperature is indicated on the display module. The Mark 2L Control panel also has direct control over what liquid nitrogen level is indicated on the display module. The Mark 2L Control panel also has direct control over the alarm annunciator and the alarm indicators.

*Conclusion 4.* On the question of "could the catastrophic failure have been avoided if DFCI had made use of the Taylor Wharton 10K liquid nitrogen cryogenic freezer's external alarm connector", I conclude that using the freezer's external alarm connector would not have prevented this failure. According to the Pacer 2L Control System manual, the external alarm will not be activated until 30 minutes AFTER the internal alarm has been activated. In this case, the internal alarms were never activated, therefore the external alarm would never have been activated either. Operation of the internal and external alarms are governed by the software instructions or program that the microprocessor is executing. Please note that since the actual source code or human-readable version of the software instructions for the Mark 2L Control panel was never produced, I cannot comment on the exact sequence of events contained within that software and I cannot locate any software "bugs" or defects in the Mark 2L Control panel software. The microprocessor used in the Mark 2L Control panel is similar to most microprocessors in that the microprocessor executes the program instructions sequentially. Some of the instructions are input instructions which allow the microprocessor to read the state of external events. Some of the instructions are output instructions which allow the microprocessor to activate external circuitry. Some of the instructions are branch-type instructions which allow the microprocessor to alter the sequence of instructions that it is performing based on certain criteria. There are other instructions that the microprocessor can perform which are beyond the scope of this report. In the Mark 2L Control Panel, an input instruction sequence gives the microprocessor the ability to monitor the state of the liquid nitrogen level within the dewar by monitoring the state of the level sensor signal conditioning circuits. A similar input instruction sequence gives the microprocessor the ability to monitor the temperature within the dewar. The microprocessor has been programmed to detect certain conditions as alarm conditions, by means of branch-type instructions. Once the microprocessor detects a condition that is defined within the program as an alarm condition the microcontroller follows the "branch" within the program that corresponds to that specific alarm condition. By reading the Taylor Wharton 10K CryoStorage System with Mark 2L Controller manual, TW-290A, and the Operating Instructions for the Pacer 2L Control System manual I understand that the external alarm will not be activated until approximately 30 minutes after the internal alarm is activated. From reading the schematic diagram I understand that there are separate circuits for the front panel alarm lamp and the audible alarm and the external alarm. The external alarm signal originates at IC2 on the schematic. IC2 is under direct control of the microprocessor and the software program that the microprocessor is executing. The external alarm signal travels along a circuit board trace from IC2 to a resistor and transistor combination. The output leg of the transistor drives a relay coil which, when activated will break electrical continuity from pin 1 to pin 2 of the external alarm connector and make electrical continuity from pin 2 to pin 3 of this external alarm connector. The audible alarm buzzer is activated in a similar fashion, except that it does not require an electro-mechanical relay to make continuity, it only requires that its resistor and transistor combination be activated by the microprocessor via IC2. The front panel alarm lamp is very similar in operation to the buzzer or audible alarm circuit. The microprocessor writes a certain value to Programmable Peripheral Interface chip, IC2, and IC2 corresponds by driving the digital "led" circuit trace to the resistor and transistor combination that activates the front panel lamp. The display module receives all its data from the commands stored in the microprocessor's software program. When the microprocessor determines that an alarm condition exists, it sends the proper sequence of data to the display module and the display module shows the alarm condition on the visible portion of the display. All alarm information must pass from the microprocessor through IC2. IC2 has multiple output pins. One of these pins drive the resistor and transistor combination that operates the front panel alarm lamp. One of these pins drive the resistor and transistor combination that operates the audible alarm buzzer. One of these pins drive the resistor and transistor combination that operates the electro-mechanical relay which in turn can activate an external alarm. Several of these pins communicate with the display module according to software instruction contained in the program. All the alarm indicators including the display module and the external alarm circuitry are under the control of the microprocessor by means of IC2, a Programmable Peripheral Interface chip. While it is true that parts of the external alarm circuit are unique, the actual operation of the external alarm circuit is very similar to audible alarm and the front panel alarm lamp. In all cases, the microprocessor determines the operation of the Mark 2L Control panel by following the sequential software instructions of its program. The sequence of these instruction is explicitly stated in both the Taylor Wharton 10K CryoStorage System with Mark 2L Controller manual, TW-290A, and the Operating Instructions for the Pacer 2L Control System manual. The sequence of instructions states that the external alarm will only be activated if the

alarm condition exists for 30 minutes. Since we know, by witness statements, that the temperature within the dewar was at ambient room temperature conditions and the dewar was warm and dry and the display module was still indicating a false cryogenic condition. The problem, in this case, is not a faulty alarm indicator or alarm indicator circuit, the problem in this case is much more pervasive. The problem extends deeper into the Mark 2L Control panel. There is no way that the connection of an external alarm system could possibly have prevented or detected or alerted anyone that this failure had occurred.

*Conclusion 5.* On the question of "does the external alarm operate off the same circuit as the internal alarm and would the external alarm had activated if the Taylor Wharton 10K liquid nitrogen cryogenic freezer was registering cryogenic conditions on its display module?" Both the internal alarm and the external alarm are driven by the Mark 2L Control Panel. Both the internal alarm and the external alarm are directly controlled by the microprocessor on the Mark 2L Control Panel. Therefore, I conclude that since the microprocessor on the Mark 2L Control Panel was not able to detect the alarm condition, it had no reason to sound either the internal alarm or the external alarm. The root of the problem is the microprocessor's ability to detect the failure. In this case, the microprocessor could not detect the failure and indicated a cryogenic condition on the display module even though the prevailing conditions within the freezer were near ambient room temperature.

*Conclusion 6.* On the question of "was BOC negligent when it sent a salesman instead of a service man to respond to a trouble call?" In my opinion, BOC was negligent in sending a salesman instead of a service technician to respond to a trouble call from a customer with as much experience using cryogenic equipment as DFCI. When a customer that is clearly familiar with the operation of cryogenic equipment calls for help, one can be confident that it is not a nuisance call. I would conclude that BOC exercised extremely poor judgment in sending a salesman that was not equipped to immediately correct the problem.

*Conclusion 7.* On the question of "did Bill Emmett do everything that was reasonable to determine the status of the freezer and should he have changed the Taylor Wharton 10K liquid nitrogen cryogenic freezer's control panel?" I do not believe that Bill Emmett did everything that was reasonable to determine the status of the freezer. I feel that Bill Emmett should have understood that when a well trained customer that is familiar with the operation of the equipment calls for help and clearly states that the display was non-responsive and the manual fill button wasn't working and the autofill mechanism wasn't working, he should have immediately become suspicious of the Mark 2L Control Panel. I conclude that freezer's control panel should have been changed that day based on the fact that the autofill mechanism and the manual fill button were at one point not operating properly, as reported by a well trained customer. According to the Taylor Wharton 10K CryoStorage System with Mark 2L Controller manual, TW-290A, and the Operating Instructions for the Pacer 2L Control System manual, the list of replacement electrical parts for the Mark 2L controller does not include any electronic parts that are soldered directly to the electronic circuit card assembly that is contained in the Mark 2L Controller. For example, one cannot order a capacitor or resistor or diode or transistor or triac or relay or DC-DC converter module or microprocessor or operational amplifier or display module, et cetera to replace a defective equivalent component that is contained within the Mark 2L Control panel assembly. One can only order the Mark 2L Control panel assembly as a complete assembly using replacement part number "R08K-9C00". In essence, the Mark 2L Control panel does not have user serviceable parts. Therefore, considering that one cannot order the small electronic components and considering that one needs to possess specialized tools and skills in order to diagnose and repair the Mark 2L Control panel, one cannot expect DFCI personnel or salesmen or unqualified personnel to effect detailed repairs to this kind of sophisticated electronic equipment in a field situation, such as at a customer's premises. Furthermore, it would be ill advised to attempt these repairs using the materials that were presented as evidence in this case, as some of those materials do not accurately reflect the actual equipment. Case in point is the schematic diagram that is marked PDS00179, this schematic diagram is missing several key components that are essential to the proper operation of the Mark 2L Control panel.

*Conclusion 8.* On the question of "did Dana Farber acted reasonably in following the instructions of BOC?" I conclude that Dana Farber employees acted reasonably when they followed the instructions of an established industry leader in the field of sales and service of specialty gasses and cryogenic equipment. Dana Farber personnel, who were familiar with the operation of cryogenic equipment, encountered a situation in which they were unfamiliar. They called in the experts who were more knowledgeable in this field. Following the instructions of BOC is a reasonable act in this case.

## Summary

Having completed my testing and analysis, I have concluded that the Mark 2L Control panel, serial number 2902, suffered a failure which caused the autofill mechanism to stop functioning, which caused the manual fill button to stop functioning

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and which caused the display module to indicate a cryogenic condition within the dewar when a cryogenic condition did not exist and which caused the multiple alarm indicators and annunciator to not operate correctly. There are no other components of the Taylor Wharton 10K CryoStorage System that could possibly fail and produce all the symptoms reported in this case. The only action that could have prevented this catastrophic failure of the Taylor Wharton 10K CryoStorage System would have been the immediate replacement of the Mark 2L Control panel, when trouble was first reported. Regarding the actual failure that occurred in the Mark 2L Control panel, in my opinion the one most likely cause of failure that could produce all of the symptoms reported, is the failure of the crystal oscillator circuit. This hypothesis was tested and verified when I caused oscillations to cease. At that time, the display module indicated a cryogenic condition, the manual fill button did not work and none of the alarm indicators or annunciators were functioning. There may be other scenarios, but the bottom line is that the root cause of the failure originated in the Mark 2L Control panel.

Respectfully Submitted,

James A. Karon

Consultant

# Curriculum Vitae

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## Education:

Bachelor of Science Electrical Engineering, Cum Laude, University of Massachusetts, Lowell, 1978

## Awards:

1978 Eta Kappa Nu, HKN, National Honor Society for Electrical Engineers
1988 Outstanding Service Award, Wavefront Control Experiment, (WCE), NASA, USAF
1993 Outstanding Service Award, United Technologies, Electrical Engineering
1997 Certificate of Recognition, Department of the Air Force
1999 Outstanding Service Award, Airborne Laser Program, (ABL), USAF

## Professional Memberships:

Institute of Electrical and Electronic Engineers, IEEE, Member since 1972
IEEE Instrumentation and Measurement Society
IEEE Electro-Magnetic Compatibility (EMC) Society
IEEE Consumer Electronics Society
IEEE Communications Society

## Positions:

OCT. 2000 – PRESENT

Consulting Engineer, Research and Advanced Development Group
L3 Communications Security and Detection Systems
Woburn, MA 01801
*Products: Explosives Detection Systems (EDS), Checkpoint Xray Systems*
*Customers: Transportation Security Administration (TSA) (TSL), various government agencies of USA, Canada, UK, Italy, France, Australia, Singapore, and others*

AUG. 1987 – OCT. 2000

Principal Engineer, Electronics Design Manager
Adaptive Optics Associates, United Technologies Corp.
Cambridge, MA 02140
*Products: Laser Beam Delivery Systems, Electro-Optic Systems*
*Customers: NASA, Lockheed, USAF, Lawrence Livermore Laboratory, others*

OCT. 1983 - AUG. 1987

Analog-Digital Project Engineer, New England Research Laboratory (NERL)
American District Telegraph (ADT)
Cambridge, MA 02139
*Products: Smoke Detection Equipment, Fire Alarm Panels, Burglar Alarm Panels, Intrusion Detection Systems, Air Quality Monitors*
*Customers: Various commercial brands*

***Curriculum Vitae***
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JAN. 1980 - OCT. 1983 Design Engineer, Operational Systems Directorate, F441
AVCO Missile Systems Division
Wilmington, MA 01887
*Products: Nuclear Weapons Systems, Nuclear Weapons Testing*
*Customers: Department of Defense (DOD), Department of Energy (DOE), TRW, Martin Marietta, others*

JUNE 1978 - JAN. 1980 Design Engineer, New Products Division
Microwave Associates Incorporated, MA/COM
Burlington, MA 01803
*Products: Waveguide and stripline Receiver Protection Devices*
*Customers: Texas Instruments (Harpoon Missile), France (Exocet Missile)*

## *Experience:*

**OCT. 2000 – Present Consulting Engineer, L3 Communications Security and Detection Syst.**

*PX2000/PXDAN:* Designed the best performing Xray Machine for the Conventional Product line (hand-carry). I developed the system concept of this machine after PerkinElmer (former owner of our division) purchased EG&G. I evaluated the hardware available at both companies and proposed the PX2000 that combined the best features of two competing products. I also designed the PXDAN, which is the front-end detection and multiplexing electronics for the PX2000 product line. In the last four years nearly one million of my detector cards have been assembled into L3 conventional products. The design is robust, very high yield and has 99% coverage on its In-Circuit Test Fixture.

*Xray Controller with 3KW Power Factor Corrector, PFC:* "Next" generation Xray controller allowed for the doubling of Xray Power without requiring higher ampacity than the typical electrical service provided by airports. The PFC allows for more efficient use of incoming electrical power. This assembly gives L3 a clear marketing advantage over all competitors. It is retrofitable into legacy products and is at the heart of all future systems in the Automated Product Line. A highly reliable Xray system that can seamlessly operate through brown-out conditions as well as over-voltage conditions while maintaining a 98+% power factor. Feedback features of this controller and improved "headroom" allow it to be compatible with less expensive Xray tubes. This controller is in the process of transitioning into full production.

*NRR Event Capture Board:* A neutron event counter with energy discrimination. Thirty-six (36) high speed photomultipliers drive wideband analog amplifiers and a 4ns window comparator. The output of the window comparator is captured by a Virtex-2 FPGA that communicates via Gigabit Ethernet to a data collection computer. The NRR Event Capture Board was designed as part of a joint experiment with MIT under a TSL Grant. The final system will require over 200 channels.

*DAS-IP:* Data Acquisition System-Interface Protocol, a scalable, high speed synchronous communication protocol that solves many of the system issues faced by large Photonic and Xray System Designers. Original concept, that I developed with two of my peers. A patent application has been submitted to the U.S. Patent Office by L3.

*CCO/Cambria/CAMC/StrobeGen/ABB/RTM/Reconstructor:* An entire fourth generation CAT Scan machine that is designed to address emerging World Standards for Xray Electronic Detection Systems. The DAS-IP is utilized to control the operation of this machine and to process and transmit large quantities of real time digital data. The StrobeGen monitors the motion of the conveyor belt, compensates for system variations and issues precisely timed strobe pulses to multiple Xray generators and to the Data Acquisition subsystem. The ABB is a low noise Amplifier Buffer Board that converts small electrical current from custom scintillator detector arrays into voltages suitable for analog to digital conversion. The CAMC board accepts 192 of these analog voltages and simultaneously digitizes them at a 40KHz rate. The data is preprocessed to compensate for gain and offset and then various digital filters are applied before transmitting the data via DAS-IP to the RTM board for data combining and segment alignment. Once the data from multiple Data Acquisition subsystems are combined,

## *Curriculum Vitae*

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In the course of the last 12 years at Adaptive Optics, I have designed, from concept to system integration, the following items:

> Nine embedded controller designs, nine low noise DC-DC modular power supplies, five backplanes, three mirror controllers, two 9KW system power supplies with 3-phase EMI filtering and lightning protection, a calibrated IR light source for an optical integrating sphere and more than twelve other interface boards and controllers.

Designed a motion control system for proprietary micro-lens machine. Well versed in the design and fabrication of mixed signal printed circuit boards, line termination, grounding, shielding and protection. Responsible for developing and implementing a preferred parts list CAD/CAM library. Wrote C and Visual Basic programs to automate error-prone tasks and improve the productivity of the Electrical Engineering Department.

**OCT. 1983 - AUG. 1987 Project Engineer, New England Research Laboratory, ADT**
Research, design and test of advanced microprocessor controlled RF communications systems, state of the art smoke detection equipment, custom instrumentation and test equipment, and exploration of new technologies resulting in improved products. Designed high voltage strobe light switching power supply, 100W ultrasonic amplifier and power driver and specialized multi-user Quality Control Parametric Test station for smoke detector certification.

**JAN. 1980 - OCT. 1983 Design Engineer, Operational Systems Directorate, AVCO**
Design, development and test of radiation hardened analog instrumentation sub-system and Deployment Module Electronics for MX missile. Design involved both analog and digital hardware, worst-case circuit analysis, nuclear hardness and survivability testing, EMC, EMP and evaluation of flight data. Utilized 8085 microprocessor for design of in-house ATE.

**JUNE 1978 - JAN. 1980 Design Engineer, New Products Division, MA/COM**
Design of prototype waveguide ferrite, bulk semiconductor and gas discharge limiters, attenuators, TR tubes and analog switch drivers.

### *Software Tools:*

Viewlogic Schematic Capture, PADS Circuit Board Design Package, TurboCAD, MS Word, MS Excel, OrCAD, FutureNET, VHDL Programming, Altera IDE, Xilinx IDE, Visual Basic 6, C Programming, Motorola HC11 Assembly Language

### *Clearance:*

Previous: Top Secret, Secret/CNWDI (Critical Nuclear Weapons Design Information)

**CERTIFICATE OF SERVICE**

I hereby certify that, July 27, 2006, I electronically filed with the Clerk of the District Court, using the CM/ECF system, plaintiff Dana-Farber Cancer Institute's Response in Opposition to Third-Party Defendants' Motion to Compel Discovery and to Amend Expert Disclosure Date.

Notice of this filing will be sent to all parties by operation of the Court's electronic filing system. Parties may access the filing through the Court's system.

s/ Peter G. Rossi
Peter G. Rossi, Esquire